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ABSTRACT

Studies indicate that there are attitudinal problems toward chemistry that keep students from achieving relevant objectives; thus, positive attitudes need to be developed by having a learning environment that fosters a warm and relaxed atmosphere in which students feel accepted and are willing to take risks in achieving complex objectives. Attitudinal objectives are vital for students to achieve since these objectives assist learners in attaining knowledge and skill objectives more thoroughly. (CCM)

Attitudinal Objectives in the Chemistry Curriculum

by
Marlow Ediger

ATTITUDINAL OBJECTIVES IN THE CHEMISTRY CURRICULUM

There are three kinds of objectives that chemistry teachers should emphasize in the curriculum. The most common kind of objectives stressed are knowledge ends. Knowledge pertains to facts, concepts, and generalizations emphasized in ongoing units of study. In these units of study, if pupils learn inductively and/or deductively that there are three states of matter-- solids, liquids, and gases-- a fact has been learned. All content needs to be learned in a meaningful manner such as pupils noticing in an experiment that raising the temperature to an appropriate level, ice as a solid changes to water, a liquid. Further appropriate raising of the temperature changes the water to steam, a gas. A variety of concrete (experiments demonstrations, use of objects and items, as well as realia), semiconcrete (videotapes, illustrations, filmstrips, films, slides, and CD ROMS), as well as abstract (listening, speaking, reading, and writing) learning activities assists the student in depth understanding of the original fact acquired.

Concepts emphasize relevant single words or phrases as objectives for students to achieve. The concept of physical properties of a substance may be analyzed in terms of hardness, color, density, boiling point, melting point and thermal or electric conductivities. When physical conditions change such as temperature, then water changes to solids or liquids. Chemical properties change when substances undergo chemical reactions. In context within an ongoing unit of study, pupils may learn the generalization "The metal called magnesium combined with oxygen, a colorless gas, forms magnesium oxide, a white solid." There are numerous concepts in this generalization, such as metal, magnesium, oxygen, gas, magnesium oxide, and solid. A generalization consists of related facts in a declarative sentence. Each concept is unique and increasingly complex to understand, unless meaning theory is stressed whereby a variety of learning opportunities are used sequentially to guide student understanding of the generalization. Vital facts, concepts, and generalizations become important objectives for pupils to achieve. If learners do not understand a major generalization, the chemistry teacher needs to teach the related concepts therein. If concepts are not understood, then relationship of facts needs to be taught in a meaningful way. Memorization is not to be encouraged, but rather pupils should understand knowledge that is stated within each objective to be achieved. A variety of learning opportunities, starting with concrete activities, followed by the semiconcrete, and then the abstract should assist students to experience a sequence which might guide more optimal achievement.

In addition to knowledge objectives, the student also needs to achieve vital skills such as those involved in problem solving. Chemists

in a laboratory setting, identify vital problems. Information from a variety of sources need to be obtained in answer to the problem. A tentative hypothesis is developed which needs testing. The hypothesis may need redoing or modifying as a result of testing. Critical and and creative thought are inherent within the problem solving experience. Critical thinking analyzes facts from opinions, reality from fantasy, as well as the relevant from the irrelevant. Creative thinking stresses the novel and the unique. Thus, the same approach used in problem solving may not always work, but a creative mind can overcome difficulties. Also, in identifying problems, the creative mind perceives gaps in information and desires to obtain knowledge to bridge the gap.

The third kind of objective to emphasize in teaching chemistry is the attitudinal end. Why are good attitudes of utmost importance in teaching and learning in chemistry? Quality attitudes can assist pupils to achieve subject matter more effectively. Quality attitudes indicate that a learner has an inward desire to learn. This inward desire to learn is vital in chemistry.

Developing Positive Attitudes in Chemistry

I have just appraised a Ph D thesis entitled Chemistry Curricular Potentials of Chemical-Based Industries (1998) for Madurai Kamaraj University, Aruppukottai, India. The author of the PhD thesis is very strong in making the following recommendations:

1. Pupils seeing the relationship between the classroom and what transpires at the work place. Too frequently, what is learned in chemistry in the classroom has no perceived relationship in terms of how the knowledge is to be used.
2. Theory and practice being related to each other, and not being separate entities. A hands on approach needs to be emphasized in teaching chemistry whereby an abstract theory is related to the utilitarian or hands on approaches in learning in chemistry.
3. Excursions to chemically based industries motivates learners and varies the kinds of learning opportunities provided.
4. Memorizing content without understanding makes for a lack of interest in learning on the part of students.
5. Learner based instruction needs to be emphasized in the chemistry curriculum. An adult centered curriculum does not meet the needs of students in chemistry.

Pupils need to perceive the chemistry curriculum as being valuable presently as well as for the future. Knowledge acquired in ongoing units of study might then have application values. What has been learned can then be used and not learned for its own sake only.

Students too frequently feel there is little value in acquiring what is being taught in chemistry in the classroom. However, with perceived application values, students do feel increased purpose or reasons for learning. Comprehension of content is vital before application can be made. Rote learning of subject matter might well provide difficulties to students in using what has been learned. Hands on approaches in teaching chemistry assists students to comprehend and thus make knowledge more usable. More positive attitudes are then an end result also.

There are attitudinal problems toward chemistry that keep students from achieving relevant objectives. Thus, positive attitudes need to be developed by having a learning environment which fosters a warm and relaxed atmosphere whereby students feel accepted and are willing to take risks in achieving complex objectives. Anxious, nervous students in ongoing chemistry lessons and units of study will hardly achieve optimally. Comprehension of subject matter in these cases will be minimized. Students' attitudes toward learning will be affected by feelings of success and active involvement and not being a passive recipient of knowledge. An end result might well be academic growth. The knowledge facet of objectives and their achievement is definitely affected by the attitudinal dimension (Morales-Jones, 1998).

Ediger and Rao (1996) stress the importance of having a variety of learning active so that students might achieve objectives more optimally. Why should there be a variety of learning opportunities in the ongoing chemistry curriculum?

1. students have different learning styles, e.g. some learn better on an individual basis as compared to others who desire to be working within a committee setting..

2. students are at different achievement levels in chemistry and individual differences need to be provided for. Since students individually are achieving at a variety of levels, the chemistry teacher needs to include teaching strategies effective for each level of attainment.

3. not all students benefit from the same kind of learning activity. The chemistry teacher needs to consider conditions and experiences under which each student may learn as much as possible.

4. teachers have different teaching styles. The style stressed needs to emphasize a learner centered chemistry curriculum. The focal point is the student when planning for instruction in chemistry.

5. selected activities capture student's interests more than do others. Interest is a powerful factor in devising strategies for teaching students.

6. individuals desire new experiences. Sameness and routineness in learning opportunities might well hinder developing learner interests in the chemistry curriculum.

7. monotony in learning activities hinders students in developing motivation for achieving objectives in chemistry.

Ediger (1995) indicates what his student teachers and cooperating teachers, whom he has supervised in the public schools, have advocated to develop good attitudes in students toward learning.

1. Assist students to become actively involved in leaning. Thus, in the chemistry laboratory encourage students individually and in committees to pursue, grow, and develop.
2. Show a caring attitude toward each student. No student should fall between the cracks. If a student does not understand what is taught, take time to make certain that meaning in learning is being achieved in the ongoing presentation.
3. Accept each student as having extreme worth and deserving respect.
4. Provide a learning environment for chemistry which is conducive to meeting student needs.
5. Recognize student capabilities and achievements so that esteem needs are being met.
6. Provide a challenging environment whereby students are motivated to attain as optimally as possible.

The Psychology of Learning and Chemistry

To assist students to achieve knowledge, skills, and attitudinal objectives as well as possible, the chemistry teacher needs to apply selected theories of learning in unit teaching. The student needs to possess adequate background information in order to understand what will be taught when initiating a new unit of study. The background information then provides readiness for students to actively achieve relevant new objectives in the chemistry curriculum. Second, the sequence of learning opportunities which follow must guide studies to make continuous optimal progress. The order of activities and experiences which follow in teaching harmonize with each student's highest possibilities for achievement. Third, the learner should be able to reveal what has been learned through additional means, other than paper/pencil testing largely/only. These additional approaches in indicating what has been learned include performing experiments, demonstrations, construction activities, project methods, and problem solving experiences. The Theory of Multiple Intelligences (Gardner, 1995) indicates that students need to have opportunities to reveal what has been learned through the personal intelligence possessed by the

involved learner. Success in learning in chemistry might then be an end result.

Constructivism, as a philosophy of teaching and evaluation, has rather recently received considerable attention as a way of education. With constructivism, the chemistry teacher appraises learner achievement in context, rather than having an outside source such as standardized tests determine what a student has learned. A student individually also should be involved in evaluating the self. With evaluation being done in a contextual situation, the student is given assistance as needed at the moment the help is needed. Guidance is provided to learners on a continual basis in context, rather than once or twice a year as was true of giving standardized tests. One facet of constructivism pertains to portfolio development. Here, the student with teacher assistance develops a collection of purposeful materials to reveal what has been learned. These materials pertain to artifacts of the everyday work of the involved student. There are numerous items that may show representative achievement of a student. The following items are provided as examples of what can become a part of a learner's portfolio:

1. dated diary entries to indicate what was learned on a daily basis in chemistry.
2. written summaries of experiments and demonstrations performed in an ongoing unit in chemistry.
3. recognized achievements or rewards received in chemistry.
4. logs kept on a weekly basis of what was accomplished in chemistry.
5. records kept on diverse media used in the classroom such as videotapes, computer disks, word processing, CD ROMS, and other visual aids.
6. progress reports issued to parents informing of personal progress in chemistry.
7. committee progress reports.
8. excursions into the community to link school and society.
9. work completed at enrichment centers in the classroom.
10. bulletin board ideas developed and displayed in the classroom.

Additional items that may be included in a portfolio include snapshots of projects completed, research papers, completed self appraisal instruments, simulations, contracts in progress or completed, and theme studies being worked on or finished. The above named items may be placed in a notebook or developed into an electronic CD ROM portfolio.

Conclusion

Students need to experience an exciting challenging chemistry

curriculum. Knowledge, skills, and attitudinal objectives need to be carefully chosen so that what is worthwhile is selected for student learning. Learning opportunities need to be sequential based on readiness for learning. Attitudinal objectives are vital for students to achieve since they assist learners to attain knowledge and skills objectives more thoroughly. A variety of activities need to be in the offing so that students achieve vital objectives in the chemistry curriculum. Caring teachers who desire to assist each student to attain as optimally as possible are important and necessary. Humanness involving respect for all and high achievement from each student is a challenge and an ideal for chemistry teachers to achieve. Students individually have talents and intelligences which need to be recognized in ongoing learning opportunities as well as in the evaluation process. Portfolio development assists students individually to reflect upon their work in chemistry and work for continuous progress. Portfolio results may be shared with parents, administrators, and guidance counselors who are interested in helping students individually learn as much as possible in chemistry (Ediger, 1997).

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